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A MODULAR INSTRUMENTATION PANEL FOR MONITORING THE STATUS OF ACCELERATOR COOLING SYSTEMS AT LOS ALAMOS *

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Abstract

A modular instrumentation panel has been designed and built for testing and installation on a linear accelerator at Los Alamos. This type of panel uses a modular approach to the monitoring of water-cooling system parameters. The panel design allows for its installation in various line sizes while using essentially the same design concept. The data taken from this instrumentation panel can be read locally or remotely and are used in several applications, namely, calorimetric measurements and fail-safe systems and alarms. A description of the panel and applications is presented.

Introduction

The concept of a modular instrumentation panel for accelerator water-cooling systems came about because of the complexity of linear accelerators and the water systems that cool them. In an effort to standardize the instrumentation used in the water system and to provide a means of monitoring water system parameters both locally and remotely, the idea of single panel or station was selected. This station would have to be versatile enough to be used in a variety of line sizes and in a broad range of temperature, pressure, and flow applications. This concept was first applied on the design of a beam stop for the GTA-1 linear accelerator. The beamstop was to have a modular panel located nearby that would provide both local and remote readouts of water system information.

This panel was not built because of a change in the scope of the GTA-1 project, it did however provide a design basis from which developed the later version of the water panel presented in this paper.

Functional Requirements

Functionally, the requirements for monitoring the various accelerator water-cooled components and subsystems are similar. The primary concerns are as follows:

1. To provide a means of determining if cooling water is flowing. If a no flow condition exists, then a signal must be generated that will not allow the accelerator to start up or that will cut power to a component and disable the accelerator beam.

2. To provide a means of determining if the cooling water meets the requirements of the various accelerator components in the areas of pressure, temperature, and flow rate. If the requirements are not being met, then the instrumentation must generate a signal that will alert operators and/or power to water cooled accelerator components.

3. To provide a means of monitoring the water-cooling system status on various accelerator components both locally at or near the component and remotely at a graphics panel and/or at the computer control center. This monitoring also provides diagnostic information that will allow potential problems in the water-cooling system to be detected before they become critical and cause accelerator shutdowns.

(4) To determine beam power deposited on the beamstop, additional functional requirements occur in the area of the accelerator beamstop where calorimetric measurements will be made. The following block diagram best illustrates the flow of information from accelerator components to local and remote stations (see Fig. 1). Note that several modular instrumentation panels can be fed into one graphics panel.

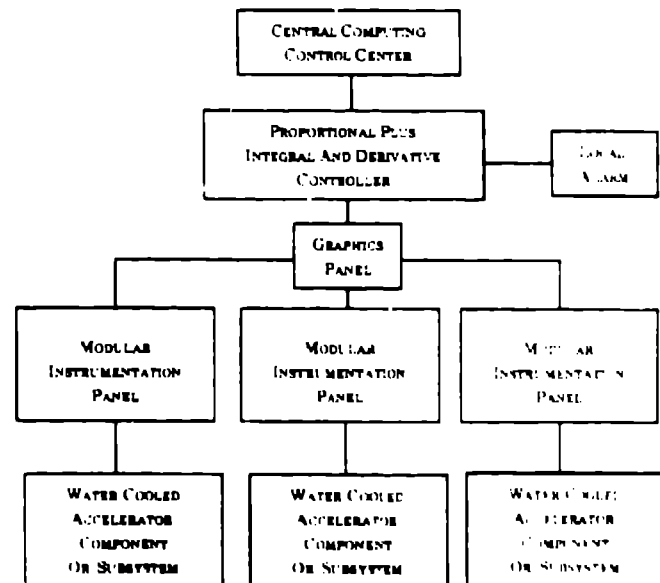


Fig. 1. Diagram showing the flow of information from accelerator components to local and remote stations.

Details of the Modular Instrumentation Panel

The modular instrumentation panel is designed to operate at a maximum working pressure of 150 psi and a maximum operating temperature of 250° F, maximum flow rates vary depending on the line size. However, a nominal flow velocity of 8 fps is generally adhered to. The panel has been designed and detailed for line sizes of 1/4, 2, 3, and 4 in. diameters. These sizes are a sampling of the versatility of the panel, other sizes may be built as necessary to meet the size and requirements of the system being monitored. The size range anticipated for the applications on the GTA linear accelerator are from 1/4 in. to 4 in. pipe diameters. It is possible that the line sizes could be as small as 1/8 in., however, difficulty in obtaining standard fittings and arrangement of instrumentation may become a concern.

A partially equipped version of the panel is currently installed on a 4 in. diameter copper piping system. This panel is built and installed to monitor cooling water flux, temperature, temperature to radio frequency (RF) power conversion, etc. This system employs only local readouts of the various parameters.

A fully equipped version of the panel is currently being fabricated. This panel has since been built and is currently installed on a Ramped Gradient Drift Tube Linac (RGDL) at the Los Alamos National Laboratory (see Fig. 2). This computer connected panel provides the capability of both local and remote readouts of pressure, temperature, and flow rate (Fig. 3). A schematic diagram of the panel is shown in Fig. 4. The panel is designed to be installed in a variety of locations and to be able to monitor a wide range of parameters.

* A preliminary report of this work was presented at the American Nuclear Society Meeting on Accelerator Technology, Los Alamos, NM, April 1981.



Fig. 2. The 425-MHz ramped gradient drift-tube nmr.

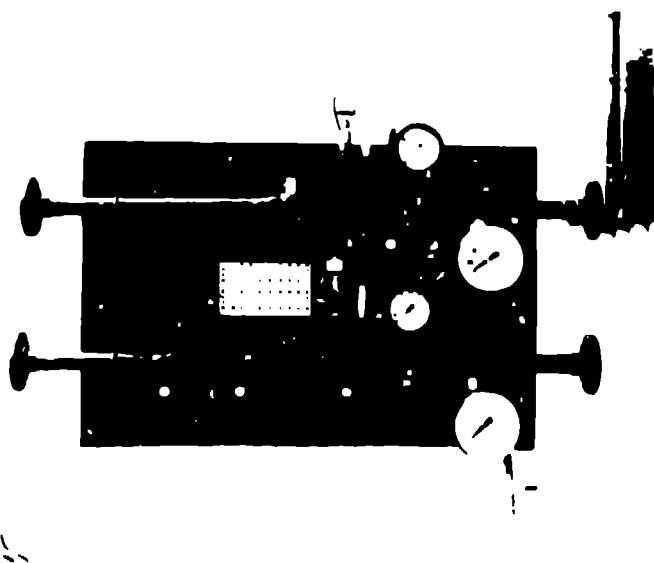


Fig. 3. Test version of the modular instrumentation panel.

to be installed or removed under a vacuum. The local instrumentation consists of liquid filled pressure gauges, thermometers, and a digital flow meter. The pressure gauges are attached with valves ahead of them, and the thermometers are inserted into thermowells allowing for removal under operational conditions. These instruments provide a quick visual check on both the supply and return cooling-water status. Remote instrumentation consists of pressure transducers, resistance temperature devices (RTDs), thermocouples, and a digital flow meter. The pressure transducers are attached with valves ahead of them and the RTDs and thermocouples are mounted in self-sealing test plugs to allow for removal while the system is in operation. The panel has also incorporated four spare access ports, two on the supply side and two on the return side, these are equipped with self-sealing test plugs and caps and are installed for emergency purposes. All remote leads are brought to the common panel jack. This is the tie-in point for remote monitoring of the cooling water system parameters. It is from this panel box that the signals are fed into a graphics panel (see Fig. 4). Having proportional plus integral and derivative (PID) controllers, the graphics panel has the capability of monitoring and controlling



Fig. 4. Graphics panel and PID controller.

the system parameters from a remote location. The graphics panel may also be connected to the computer that controls the system for additional monitoring. As stated, the graphics panel can monitor several instrumentation points. If there is a problem within the water system, such as a low flow, the graphics panel, then an alarm system will sound to notify the operator that a problem exists and will alert the operator to solve the problem. The graphics panel has not been used in the system, but it is a part of the system and will be used in the future.